Entropy Gradient Propulsion – A Brief Overview

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In this short paper I'm going to describe a concept I'm exploring for a new type of propulsion system. In this system, the hull of the spacecraft is constructed of a special metamaterial and is itself the "engine" that propels the craft. The concept is explained in more detail in the following paragraphs.

The metamaterial is essentially a "stack" of Casimir cavities. Each cavity consists of a tunable dielectric material sandwiched between two conductive layers. The stack would contain as many cavities as is practical with existing semiconductor manufacturing techniques.

I realize, of course, that a Casimir cavity produces a very, very small force (microscopic), but we're not interested in the force produced. Instead, we're interested in the suppression of vacuum fluctuations inside the cavity.

This region of suppressed vacuum fluctuations will have a much lower entropy than the surrounding space. By "stacking" or "layering" of these cavities we can greatly increase the size of this low entropy zone.

The low entropy region will not extend very far beyond the hull, but will form a thin boundary layer much like the low pressure region formed on the top of an airfoil as described by Bernoulli's Principal.

According to Erik Verlinde's theory of emergent gravity, the surrounding high entropy space will "push" on the low entropy region of the spacecraft in an attempt to equalize the entropy of space-time.

Another way to think of it is the spacecraft "falls" into the low entropy “trough” created by the region of suppressed vacuum fluctuations. This is an entirely new concept of propulsion that does not require thrust or a reactionary force as described by Newton's third law. As such, conventional equations to calculate force based on mass *may* not apply here.

The craft is "steered" or "controlled" by moving this region of low entropy around the hull of the craft. The craft will move in the direction of the low entropy zone.

This control is accomplished with a pulsed magnetic fields. The dialectric layer of the Casimir cavity is made from a material whose permittivity is tunable by the magnetic field. By changing the permittivity of this layer, the suppression of vacuum fluctuations in the Casimir cavities may be increased or decreased as needed.

That's the concept in a nutshell.

I know it's highly speculative, but I have researched suitable dialectric materials with permittivity that respond well to magnetic fields and the metamaterial could be constructed using existing semiconductor manufacturing techniques. Power requirements to drive the electromagnetic coils would be in the kilowatt range.

The inspiration for propulsion system came from material that was allegedly recovered from the famous Roswell UFO crash. I believe the material was originally mailed to Art Bell who was the host of the Coast to Coast radio show. Eventually, it ended up in the hands AARO (All-Domain Anomaly Resolution Office) who had it analyzed by Oak Ridge National Laboratory.

The sample was relatively small. From the report it appears to be about 2 to 3 mm in thickness. It also appears to have suffered damage due to heat and/or mechanical stress -- possibly a result of the crash. It is a layered material and appears to consist of about 10 layers with the top three layers "peeling" away from the bulk.

The interesting aspect is the layers are composed of alternating magnesium-zinc alloy separated by a layer of crystalline bismuth. The bismuth layer is a few microns thick. Based on the number of layers and the thickness of the sample, I would guess the MgZn layers are roughly 100 microns thick.

The prevailing theory is that the material forms a waveguide for terahertz signals.

When I first learned of this material, knowing MgZn are conductive metals and bismuth is a semi-metal, I immediately thought of Casimir cavity.

I won't go into great detail about the Casimir effect. You can read about it on Wikipedia, but I'll give a brief description of it here.

In 1948, a Dutch physicist, Hendrik Casimir, found that when you place two, uncharged conductive plates very close to one another these plates experienced an attractive force that pushes them together.

The plates have to be placed extremely close to one another. They have to be just a few nanometers apart. To give you an idea of the scale, a cell wall is around 5 to 10 nanometers thick.

One interpretation of this effect suggests that the space between the conductive plates contains fewer vacuum fluctuations than the space surrounding the plates. It is thought that this imbalance in density or concentration of vacuum fluctuations is what pushes the plates together.

We'll come back to this later, but for now it is worth noting that our propulsion system does not rely on the force pushing the plates together. Instead, the Casimir plates are merely used to create regions of suppressed vacuum fluctuations or low entropy zones.

One discrepancy you may notice is that the Casimir effect relies on the plates being only 10 to 100 nanometers apart. Much shorter distance than the 3 or so micron thick bismuth layer described by the ORNL analysis (1 micron = 1,000 nanometers). But I will explain later why this is not a problem and is actually necessary for the propulsion system to exist in a quiescent state.

So, when I learned of this metamaterial my mind instantly went to Casimir effect and I wondered how a spacecraft might used this material. Also, rolling around in my head was Erik Verlinde's theory of entropic gravity and that's when I made the connection.

A Casimir cavity suppresses or limits the number of vacuum fluctuations or energy states that can exist between the plates. Now this is quantum physics and way beyond what I want to discuss here, but I guess a quick explanation might be helpful.

So another theoretical concept is that "empty space isn't really empty". The idea, simply put, is that in the "vacuum" of empty space there are little bits of energy that are constantly popping into and out of existence. And, in deep space, far from any planet or star, there is a wide distribution of these vacuum fluctuation "modes". In other words, there's more variety. This results in higher entropy which is loosely defined as a higher degree of randomness.

But as you get closer to matter, like planets and stars, the matter imposes boundary conditions (like the Casimir plates) and this constrains which vacuum fluctuation “modes” can occur.

It's important to understand the concept of entropy because this is central to how our propulsion system works. In thermodynamics, a system will tend to proceed from lower entropy (organized) to higher entropy (random). Think of a melting ice cube.

The universe will try to "maximize" entropy. This is exactly how Erik Verlinde's model of emergent gravity works. It is the universe trying to maximize entropy that warps or bends space time around large collections of "organized" matter such as the Earth and Sun. In science, this imbalance between two regions is called a "gradient" and this is the "force" we're going to exploit in our propulsion system.

So lets circle back. If we can create a region of low entropy (suppressed vacuum fluctuations) on one side of our spacecraft, then the universe will bend space-time around the spacecraft in an attempt to maximize entropy. This will have the effect of "pushing" our spacecraft through space like a bubble flowing down stream.

Another way to visualize this is in terms of osmosis. In osmosis, a solution tries to equalize the concentration of a solute across a semipermeable membrane (boundary). In our propulsion system, space-time is the osmotic “solution” and the spacecraft is the “solute”. The boundary is the layer of suppressed vacuum fluctuations we create along the leading edge of the craft.

Just as in osmosis, the solute particle doesn’t experience any forces or acceleration. It is just carried along by the solution. It’s the solution that experiences the forces and accelerations.

Therefore, inside the craft, the occupants won’t experience any acceleration in their “isolated” inertial frame. The craft itself will not experience any forces, it will just be carried along by space-time as it re-arranges itself to establish entropic equilibrium.

So, in summary:

By creating a region of suppressed vacuum fluctuations (low entropy) on one side of the spacecraft, the universe bends space-time to restore balance. This curvature manifests as a directional push, propelling the craft without ejecting mass — like a bubble flowing through a stream of entropy.

Finally, let's return to our sample retrieved from a crashed UFO. Would this sample be a good candidate for our propulsion system? I say yes. Let me explain why.

Bismuth is highly responsive to magnetic fields. It's permittivity can be influenced by magnetic fields. By applying a pulsed magnetic field perpendicular to the bismuth layers we can control how strongly it suppresses the vacuum fluctuations.

The MgZn alloy is highly conductive, light weight and structurally strong. All three materials are readily available on Earth and can be combined using conventional semiconductor technology to create a strong, light weight hull that will suppress vacuum fluctuations when properly stimulated by a pulsed electromagnetic field.